<u>Amendments to the Specification</u>:

Please replace the paragraphs indicated below with the accompanying rewritten paragraphs:

a1 **[0001]** This application is a continuation-in-part of ~~copending~~ U.S. Pat. Application No. 09/425,316, filed October 21, 1999, for COMPACT LIGHT PATH AND PACKAGE FOR LIQUID CRYSTAL PROJECTION DISPLAYS<u>, now U.S. Pat. No. 6,273,570</u>.

a2 **[0003]** This invention relates to video projection displays and more particularly to an apparatus and <u>a</u> method for improving the resolution, image size, brightness, and useful life of such displays.

[0005] When an array of such displays [[are]] <u>is</u> configured in a multiscreen arrangement, additional problems arise because of difficulties <u>in</u> achieving visually seamless display boundaries among the displays. In particular, arrayed projection displays require a3 precise image edge matching and uniformly bright luminance across the entire projected image. Multiscreen displays exacerbate any image matching and nonuniformity problems because each display provides a subdivided portion of a total image, the multiple boundaries of which must appear as inconspicuous as possible. Unfortunately, when using projection displays in a multiscreen arrangement, it is especially difficult to achieve a visually seamless display because of luminance and color nonuniformities and geometric distortions that typically exist from screen to screen and from the center-to-edge of each screen. These problems effectively eliminate magnetically deflected cathode-ray tube displays from use in arrays.

[0006] Projection displays employing digitally addressed light valves have evolved to a point where many of the above-described problems can be solved. In particular, liquid crystal light valves have enabled implementing cost-effective, high resolution displays, albeit with some remaining luminance, uniformity, contrast ratio, and life problems. Solutions to some of these problems are described in U.S. Pat. No. 6,043,797 for COLOR AND LUMINANCE CONTROL SYSTEM FOR LIQUID CRYSTAL PROJECTION DISPLAYS and ~~copending allowed U.S. Pat. Application No. 09/425,316, filed October 21, 1999,~~ <u>U.S. Pat. No. 6,273,570</u> for COMPACT LIGHT PATH AND PACKAGE FOR LIQUID CRYSTAL PROJECTION DISPLAYS ~~(" '316 application")~~, both of which are assigned to the assignee of this application and are incorporated herein by reference.

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[0008] Various models of liquid crystal light valves (hereafter "LCDs") are available including transmissive, reflective, monochrome, color, and small- and large-panel configurations. Small panel LCDs are commonly used in portable and conference room multimedia projectors. Their current resolution is limited to SXGA format on a 4.57 cm (1.8 inch) diagonal monochrome polysilicon (transmissive or reflective) LCD used in costly 3-path color video projectors. To achieve a useable projected image brightness, very intense light impinges on the LCDs and is magnified 33X to100X by a projection lens to achieve a useable image size. Unfortunately, maintaining SXGA image quality with the 33X to 100X magnification ratio requires using a relatively expensive 11-15 element wide-angle projection lens. Moreover, the high ~~light~~ intensity light impinging on the polysilicon LCDs causes ~~its~~ their failure by rapid discoloration after about 10,000 hours of use. Also such LCD projection displays have a contrast ratio of less than about 500:1.

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[0013] A high performance rear screen projector of this invention employs a modified 380 mm (15 inch) diagonal, high resolution, amorphous silicon, LCD panel for receiving intense light rays from an arc lamp light source. The light source achieves a small effective source size relative to the LCD panel size by employing four lamps with 1.3 mm arc gaps and a "pinwheel" mirror configuration that reflects and overlaps light rays from each of the arc lamps into a single collimated light bundle. The small effective source size produces a very small cone angle of light propagating through the LCD panel. A Fresnel lens directs the narrow cone of light though the LCD panel at an optimal ray angle for achieving a 1,500:1 image contrast ratio. Because of the large size of the LCD panel, only a 4X magnification ratio is required to achieve a 170 cm (67 inch) diagonal projected image. The small magnification ratio enables projecting SXGA or greater resolution images with a relatively low cost five or fewer element ~~or less~~ projection lens. The large, amorphous silicon LCD panel achieves an operational life of at least 50,000 hours before the projected images display color degradation.

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[0015] Additional objects and advantages of this invention will be apparent from the following detailed description of preferred embodiments thereof that ~~proceed~~ proceeds with reference to the accompanying drawings.

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[0017] Figs. 2 and 3 are respective front and right side pictorial elevation views showing structural components of an LCD projection display package of this invention[[.]] arranged in a first operational configuration.

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[0023] Figs. 9A, 9B, 9C, and [[9C]] 9D are pictorial side views representing LCD illumination cone angles produced by illuminating various combinations of small and large LCD panels with small and large light sources.

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[0028] Figs. 2 and 3 show respective front and right side views of a representative one, for example 12N, of projectors 12 of this invention. The mechanical packaging of LCD projector 12N is stackable and includes a pedestal portion 20 and a housing portion 22. Pedestal portion 20 is supported by respective left and right legs 24 and 26 that are attached by screw fasteners [[30]] 28 threaded into PEM nuts [[32]] 30 that are pressed into the bottom side margins of pedestal portion 20. Left and right legs 24 and 26 preferably protrude forward from the left and right bottom side margins of pedestal portion 20.

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[0040] Despite the remaining drawbacks of direct view LCD panel 90, this invention provides modifications ~~thereto~~ to LCD panel 90 that optimize its contrast ratio and render it suitable for use in projection displays.

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[0050] Because intense light propagates from light ~~source70~~ source 70 (Fig. 6), the substrate 122 side of LCD assembly 80 should face light source 70 so the black mask associated with substrate 96 will prevent the TFTs thereon from unintentionally photoconducting. This light propagation direction is opposite from the direction originally intended for direct view LCD panel 90.

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[0052] The light transmission through amorphous silicon LCD assembly 80 is inefficient (only about 7 percent), but adequate in view of the objects and advantages that are achieved. The light transmission inefficiency is offset by the high intensity of light source 70, which is described with reference to Figs. 11 and 12.

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[0056] However, if some of the light rays pass through the LCD at angles that diverge from the optimal ray angle, the contrast ratio will be an average of the contrast ratio achieved by all of the light rays. In other words, the peak contrast ratio is ~~only~~ achievable only if all the light rays pass through the LCD with very little divergence from the optimal ray angle (a small cone angle). Accordingly, this invention seeks to achieve a high contrast ratio by passing light rays through LCD assembly 80 at the optimal ray angle and with a very small cone angle, preferably less than about ±6 degrees.

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[0057] Figs. 9A, 9B, 9C, and [[9C]] 9D show LCD illumination cone angles 130 produced by illuminating various combinations of small LCD panels 132 and large LCD panels 134 with small light sources 136 and large light sources 138. As a general rule, LCD illumination cone angle 130 conforms to the following relationship:

LCD Cone Angle = [(Source Cone Angle)(Source Height)]/LCD Height.

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[0060] Fig. 10 shows a preferred way of achieving an optimal ray angle 140 for propagating principal ray 72 and image margin light rays 74 through LCD assembly 80. Input and output Fresnel lenses 78 and 82 are mounted adjacent and parallel to LCD assembly 80. Input Fresnel lens 78 has a focal length F_I and an optical center 142 that is offset downward a distance 144 from a geometric center 146 of input Fresnel lens 78. Principal ray 72 enters input Fresnel lens 78 at and perpendicular to geometric center 146. Likewise, output Fresnel lens 82 has a focal length F_O and an optical center 148 that is offset upward a distance 150 from a geometric center 152 of output Fresnel lens 82. Principal ray 72 exits output Fresnel lens 82 at and perpendicular to geometric center 152. The ~~differential offsets of optical centers 146 and 150, cause~~ offset of optical center 142 causes diffraction of principal ray 72 and image margin light rays 74 such that they propagate through LCD assembly 80 at a five degree downward angle, which in the preferred embodiment, is optimal ray angle 140.

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[0064] The benefits of light source 70 are better understood by first understanding that prior LCD projectors typically employ a single high efficiency lamp, usually a metal halide arc lamp, housed in a reflector that directs as much of the light as possible toward the LCD. A parabolic reflector may be employed to produce a collimated beam of ~~light~~ light, or an elliptical reflector may be employed to produce a focused beam of light. However, either type of reflector produces a non-uniform distribution of light intensity that is generally brighter toward the center of the beam and dimmer towards the edges. The beam is also circular in shape, which causes a significant illumination loss around the edges of the typically rectangular LCD.